CHEMICAL AND BIOLOGICAL DEFENSE PROGRAM

General Information

In response to Congressional interest in the readiness and effectiveness of U.S. Nuclear, Biological and Chemical (NBC) warfare defenses, Title XVII of the National Defense Authorization Act for Fiscal Year 1994 (Public Law 103-160) required the Department of Defense (DoD) to consolidate management and oversight of the Chemical and Biological Defense (CBD) program into a single office within the Office of the Secretary of Defense. The public law also directed the Secretary of Defense designate the Army as the Executive Agent for coordination and integration of the CBD program. The executive agent for the Small Business Innovation Research (SBIR) portion of the program is the Army Research Office-Washington (ARO-W).

The objective of the DoD CBD program is to enable U.S. forces to survive, fight and win in chemical and biological warfare environments. Numerous rapidly-changing factors continually influence the program and its management. These forces include declining DoD resources, planning for warfighting support to numerous regional threat contingencies, the evolving geopolitical environment resulting from the breakup of the Soviet Union, U.S. participation in the Chemical Weapons Convention, and the continuing global proliferation of chemical and biological weapons. Improved defensive capabilities are essential in order to minimize the impact of such weapons. U.S. forces require aggressive, realistic training and the finest equipment available that allows them to avoid contamination, if possible, and to protect, decontaminate and sustain operations throughout the non-linear battlespace. Further information about the DoD CBD Program (and related programs) is available at the DoD Counterproliferation and Chemical Biological Defense Homepage at Internet address http://www.acq.osd.mil/cp/.

The overall objective of the CBD SBIR program is to improve the transition or transfer of innovative CBD technologies between DoD components and the private sector for mutual benefit. The CBD program includes those technology efforts that maximize a strong defensive posture in a biological or chemical environment using passive and active means as deterrents. These technologies include chemical and biological detection; information assessment, which includes identification, modeling and intelligence; contamination avoidance; and protection of both individual warfighters and equipment.

Tri-Service Program

The U.S. Army, Navy, and Air Force have developed separate SBIR topics for research and development in various CBD areas of interest. As lead agency, the Army will coordinate Tri-Service efforts related to the receipt, evaluation, selection, and award of Phase I proposals and similarly for potential follow-on Phase II efforts under this program.

Submitting Your Phase I CBD SBIR Proposal

The CBD SBIR Program now requires that a proposing firm have Internet access via the World Wide Web, in order to submit its Phase I SBIR proposal – in its entirety – online. You must also submit an original and two copies via mail or other delivery means (See 4. Postal Submission below). Please review and follow these procedures when submitting each Phase I proposal:

1. Online Submission: The entire proposal including all forms must be submitted via the Internet. Visit the Army SBIR Website at http:/www.aro.army.mil/arowash/rt to get started. This page has a link to the DoD-wide SBIR proposal submission system (available directly at http://www.dodsbir.net/submission). The DoD system will lead you through the preparation of the following proposal sections:

   a. Proposal Cover Sheet (formerly Appendices A & B) – Pages 1 and 2 of your proposal)
   b. Company Commercialization Report (formerly Appendix E) (does not count against page limit)

Once the Proposal Cover Sheet is saved in the DoD system, you will be asked to upload your Technical Proposal and Cost Proposal (Reference A of this solicitation) via the website.

2. Acceptable Formats for Online Submission: All technical proposal files will be converted to Portable Document Format (PDF) for evaluation purposes; therefore, the Technical Proposals should be submitted in PDF format. Other acceptable formats (PC/Windows) are: Text, Rich Text Format (RTF), MS Word, WordPerfect, and Adobe Acrobat. The Technical Proposal should include all graphics and attachments, should conform to the limitations on margins and number of pages, and should exactly reflect the hardcopy version. Offerors are responsible for performing a virus check on each submitted Technical Proposal. Each submitted electronic technical proposal will be scanned for viruses. The detection of a virus on any submitted electronic Technical Proposal may cause rejection of the proposal.

3. **Note:** Firms without Internet access must request an exemption by calling 703-617-7425 no later than 7 January, 2000. Additional instructions will be provided.

4. Postal Submission: Postal submission includes an original signed proposal with all forms and required attachments, plus two copies. All proposals written in response to topics in this solicitation must be received by the date and time indicated in Section 6.2 of the introduction to this solicitation. Offerors are advised to submit proposal(s) well before the deadline. **Late proposals will not be accepted.**

All Phase I proposals - one original (clearly marked, with original signatures) and two copies - must be submitted to the CBD SBIR Program Management Office at the address below. Each copy must include Proposal Cover Sheet, Cost Proposal, and the Company Commercialization Report. All hand deliveries must be made to the Army Materiel Command (AMC) building mail room, located at the rear of the AMC building. Proposers should be aware that the AMC mail room hours are 0730-1530 hrs (local) and are subject to change without prior notice. *Offerors using non-government courier services assume the risk for late delivery of proposals.

Mail proposals to:
Dr. Kenneth A. Bannister
U.S. Army Research Office-Washington
Room 8N31, Army Materiel Command Building
5001 Eisenhower Avenue
Alexandria, VA 22333-0001
(703) 617-7425

Potential offerors must follow the proposal content rules for the agency which has proponency for topics. Topics are numbered in series, with Army topics starting at 101, Navy topics starting at 201, and Air Force topics starting at 301. Detailed instructions for proposals to be submitted against Army topics are given below. **Refer to the appropriate Navy and Air Force sections in this Solicitation for information on how to prepare proposals for submission against Navy and Air Force CBD topics.**

Army Proposal Guidelines

The Army has enhanced its Phase I-Phase II transition process by implementing the use of a Phase I Option that the Army may exercise to fund interim Phase II activities while a Phase II contract is being negotiated. The maximum dollar amount for a Phase I feasibility study is $70,000. The Phase I Option, which **must** be proposed as part of the Phase I proposal, covers activities over a period of up to four months and at a cost not to exceed $50,000. All proposed Phase I Options must be fully costed and should describe appropriate initial Phase II activities which would lead, in the event of a Phase II award, to the successful demonstration of a product or technology. **The Army will not accept Phase I proposals which exceed $70,000 for the Phase I effort and $50,000 for the Phase I Option effort**. Only those Phase I efforts selected for Phase II awards through the Army's competitive process will be eligible to exercise the Phase I Option. To maintain the total cost for SBIR Phase I and Phase II activities at a limit of $850,000, the total funding amount available for Phase II activities under a Phase II contract following an Option effort will be $730,000.

Companies submitting a Phase I proposal to the Army under this Solicitation must complete the Cost Proposal (Reference A of this solicitation) within a total cost of $70,000 (plus up to $50,000 for the Phase I Option). Phase I and Phase I Option costs must be shown separately; however, they may be presented side-by-side on a single Cost Proposal. The Phase I Option proposal must be included within the 25-page limit for the Phase I proposal. In addition, all offerors will prepare a Company Commercialization Report, for each proposal submitted. The Company Commercialization Report does not count toward the 25-page limitation.

Selection of Phase I proposals will be based upon scientific and technical merit, according to the evaluation procedures and criteria discussed in this solicitation document. Due to limited funding, the Army reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality will be funded.

Proposals not conforming to the terms of this solicitation, and unsolicited proposals, will not be considered. Awards are subject to the availability of funding and successful completion of contract negotiations.

Army Phase II Proposal Guidelines

CBD Phase II proposals are invited by the individual Service from CBD Phase I projects that have demonstrated the potential for commercialization of useful products and services. The invitation will be issued by the Service organization responsible for the Phase I effort. Invited proposers are required to develop and submit a commercialization plan describing feasible approaches for marketing the developed technology. Fast Track participants may submit a proposal without being invited. Cost-sharing arrangements in support of Phase II projects and any future commercialization efforts are strongly encouraged, as are matching funds from independent third-party investors, per the SBIR Fast Track program (see section 4.5 of the introduction to this solicitation). Commercialization plans, cost-sharing provisions, and matching funds from investors will be considered in the evaluation and selection process, and Fast Track proposals will be evaluated under the Fast Track standard discussed in section 4.3 of the introduction to this solicitation. Phase II proposers are required to submit a budget for a base year (first 12 months) and an option year. These costs must be submitted using the Cost Proposal format in Reference A of this solicitation, and may be presented side-by-side on a single Cost Proposal Sheet. The total proposed amount should be indicated on the Proposal Cover Sheet, under "Proposed Cost". Phase II projects will be evaluated after the base year prior to extending funding for the option year.

Phase II Plus - The Army has established the ***Phase II Plus*** Initiative, effective immediately, as a three-year pilot program to facilitate the rapid transition of SBIR technologies, products, and services into Army or other DoD acquisition programs. Under ***Phase II Plus***, the Army provides matching SBIR funds to expand an existing Phase II that attracts investment funds from an acquisition program. Private sector investments will also be considered for ***Phase II Plus*** funding. ***Phase II Plus*** allows for an existing Phase II Army SBIR effort to be extended for up to one year to perform additional research and development. ***Phase II Plus*** matching funds will be provided on a dollar-for-dollar basis up to a maximum $100,000 of SBIR funds. All ***Phase II Plus*** awards are subject to acceptance, review, and selection of candidate projects, are subject to availability of funding, and successful negotiation and award of a ***Phase II Plus*** contract modification. Details and groundrules for this program may be found at the Army SBIR Website, http://www.aro.army.mil/arowash/rt/.

The Army is committed to minimizing the funding gap between Phase I and Phase II activities. With the implementation of Phase I Options, all Army Phase II proposals will receive expedited reviews and be eligible for interim funding. Accordingly, all Army Phase II proposals, including Fast Track submissions, will be evaluated within a single evaluation schedule.

Key Dates

00.1 Solicitation Open	1 December 1999 – 12 January 2000
Phase I Evaluations	January - April 2000
Phase I Selections	April 2000
Phase I Awards	May 2000

PROPOSAL CHECKLIST

This is a Checklist of Requirements for your proposal. Please review the checklist carefully to assure that your proposal meets the Army SBIR requirements. **Failure to meet these requirements will result in your proposal not being considered for review or award**. Do not include this checklist with your proposal.

______1. The proposal cost adheres to the individual Service (Army, Navy, or Air Force) criteria specified.

_____ 2. The proposal is limited to only **ONE** solicitation topic. All required documentation within the proposal references the same topic number.

______3. The proposal, including the Phase I Option Cost Proposal, is 25 pages or less in length. (Excluding the Company Commercialization Report.) Proposals in excess of this length will not be considered for review or award.

_____ 4. The entire proposal including all forms must be submitted via the Internet using the DoD's Online SBIR Proposal System which can be accessed at address: http:// www.aro.army. mil/arowash/rt/.

_____ 5. The Proposal Cover Sheet (formerly, Appendix A and B), is the first two pages of your proposal. The Proposal Cover Sheet clearly shows the proposal number assigned by the system to your proposal and is signed. The Technical Abstract contains no proprietary information, does not exceed 200 words, and is limited to the space provided. Cost Proposal (Reference A). is complete, signed, and is included as the last section of the proposal. (For Army topics the **Phase I and Phase I Option** costs must be shown separately on the Cost Proposal).

_____ 6. The Company Commercialization Report is submitted in accordance with Section 3.4.n. This report is required even if the company has not received any SBIR funding. (This report does not count towards the 25-page limit)

_____ 7. The proposal contains only pages of 8-1/2" X 11" size. No other attachments such as disks, and video tapes are included. The proposal contains no type smaller than 11-point font size (except as legend on reduced drawings, but not tables). The proposal is stapled in the upper-left-hand corner, and no special binding or covers are used.

_____ 8. An original with original signatures as required **(clearly marked)** and two copies of the proposal are submitted. The proposal must be sent registered or certified mail, postmarked by January 5, 2000, or delivered to the Army SBIR Office no later than **January 12, 2000, 3:00 p.m. local time** as required (see Section 6.2). Offerors who elect to use commercial courier services do so at their own risk. The Army **cannot** accept responsibility for proposals delivered late by commercial couriers.

_____9. Include a self-addressed, stamped envelope and a copy of the Notification Form (Reference C) located in the back of the solicitation book, if notification of proposal receipt is desired. **No responses will be provided if these are not included with your proposal**.

INDEX OF CHEMICAL BIOLOGICAL DEFENSE FY00 TOPICS

Army CBD Topics

Navy CBD Topics

Air Force CBD Topics

CBD00-301 Discrimination of Biological Agents At Moderate Standoff Ranges

CBD00-302 In-flight Decontamination

CBD00-303 Thin, Flexible Chemical Agent Resistant Materials

CBD00-304 Open Wound Decontamination

CBD00-305 Multi-Component Adsorption Data and Modeling

CHEMICAL BIOLOGICAL DEFENSE FY00 TOPICS

Army CBD Topics

CBD00-101 TITLE: Miniaturized Sample Preparation Module

TECHNOLOGY AREAS: Chemical/Biological Defense

OBJECTIVE: Development of sample preparation modules to interface with Micro-electromechanics and micro-electronics (MEMS) sensors.

DESCRIPTION: MEMS technology has reduced the size and power requirements for detection of genetic material from microorganisms using Polymerase Chain Reaction (PCR). To date, however, portable detectors are suitcase size and require manual addition of a single colony culture. A remaining challenge is the miniaturization of sampling devices. Such devices could be for aerosols, water sampling or soil samples that could be interfaced with existing MEMS sensors. Much development is required in the area of automated sample cleanup since the purity of DNA in small devices is much more critical.

PHASE I: Current sample collecting or sample preparation systems will be cataloged and evaluated for miniaturization. One or more devices will be selected along with MEMS sensor(s) into which it will interface.

PHASE II: : A miniaturized device will be constructed and demonstrated. Integration with the MEMS sensor device(s) selected in Phase I will be conducted for development of a complete biosensor system ready for field tests. Initial packaging and interface standards will be presented for possible incorporation into ASME or MIL standards.

PHASE III DUAL USE APPLICATIONS: Development of miniaturized sample collection and preparation devices would greatly accelerate commercialization. Such devices could be used in medical, environmental monitoring and food preparation areas.

KEYWORDS: sample preparation, PCR, MEMS sensor

REFERENCES: Belgrader, P., et.al. "PCR Detection of Bacteria in Seven Minutes," Science, 284:449-450, 1999.

CBD00-102 TITLE: Improved Sensitivity for Chemical and Biological Standoff Detection

TECHNOLOGY AREAS: Chemical/Biological Defense

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PM, Nuclear, Biological, & Chemical Defense Systems

OBJECTIVE: Establish technical feasibility of developing a means of obtaining greatly increased sensitivity of standoff chemical and biological (CB) detection.

DESCRIPTION: Innovative and creative approaches to this research and development effort are requested to establish the technical feasibility of producing higher-sensitivity LIght Detection And Ranging (LIDAR) standoff CB detectors. Development of such a device directly supports both short-range (Joint Service Warning and Identification LIDAR Detector, also a Defense Technology Objective - DTO) and long-range (Miniature Standoff Agent Detector) goals for Contamination Avoidance identified in the Joint Service Nuclear, Biological, and Chemical (NBC) Defense Research, Development, and Acquisition (RDA) Plan, and outlined in its Chemical Detection Roadmap. These standoff detectors also support Army as well as Joint Service goals in Wide Area Decontamination by identifying and mapping areas requiring decontamination.

Significant flexibility is allowed in formulating proposed approaches to meet these goals. Current LIDARs (e.g. Reference 1) for standoff CB detection uniquely identify CB agent spectral features by measuring the laser energy at each wavelength that has passed through the cloud. The ultimate sensitivity of the measurement depends on the signal to noise ratio. Current LIDARs are capable of detecting small fractions (1/10 to 1/100) of the dose that will produce a lethal effect in 50% of poisoning cases, (lethal dose known as "LD50"). However, even this sensitivity is not sufficient to determine completely safe boundaries for areas that have been under attack (due to long-term effects of low-level exposures). Nor is it sufficient to measure suspected areas of weapon manufacture. In order to do these tasks, the sensitivity must be raised by about a factor of ten. Current carbon dioxide (CO_2) LIDARs using Transversely Excited Atmospheric (TEA) lasers can attain 2% noise levels consistently by pulse averaging. The desired factor of ten sensitivity increase can only be accomplished by reducing the noise of the system by a factor of ten. Among the methods to be considered are: 1) signal averaging to levels consistently less than 1% noise with a goal of 0.1%, 2) further reducing instrument noise, such as with lower noise detector elements and/or preamplifiers, better energy normalization techniques, and better shielding, 3) coherent detection, including the possibility of utilizing detector arrays in order to reduce transmitter repetition rate requirements.

If the approach is successful, it could be integrated into the CO2 TEA laser-based JSWILD acquisition program to enhance its CB detection capabilities to include very low level detection. The Program Manager for NBC Defense Systems would be interested in providing non-SBIR funding during or after Phase II to integrate this capability (see attachment) into JSWILD.

PHASE I: All efforts are to be directed toward establishing the feasibility of increasing the sensitivity of the TEA CO2 LIDAR as described above. The limitations of signal averaging shall be defined theoretically and experimentally and shall include the effects of speckle, atmospheric effects and field of view of the LIDAR. Instrumentation effects shall be identified and experiments will be performed to indicate the degree of improvement over conventional devices.

PHASE II: A breadboard TEA CO2 LIDAR shall be constructed and tested utilizing a GFE CO2 laser transmitter to demonstrate technical feasibility of the approach. The device will be capable of consistently achieving noise levels of less than 0.2% with a goal of 0.1%. That is, the sensitivity of the breadboard LIDAR will be demonstrated to be greater than 10 times that of the current device. The performance will be verified by means of outdoor testing utilizing realistic topographic targets.

PHASE III DUAL-USE APPLICATIONS: Phase III military applications include full-sized and miniature standoff CB detectors for contamination avoidance and decontamination. In addition, dual-use intelligence and domestic preparedness applications could directly benefit from having a standoff detection device with greatly increased sensitivity. Phase III commercial applications include spin-off detectors for standoff environmental pollution monitoring and for drug interdiction.

KEYWORDS: chemical, biological, detection, carbon dioxide laser, LIDAR, standoff, sensitivity, system noise.

REFERENCES: Wavelength Agile CO2 Laser and Chemical Sensor, Cohn, D. B., Fox J. A., Swim, C. R., SPIE Proceedings, Vol. 2119, p. 72-82, January 1994.

CBD00-103 TITLE: Detection and Identification of Buried or Concealed BW Agents and Simulants using Nuclear Quadrupole Resonance Spectroscopy

TECHNOLOGY AREAS: Chemical/Biological Defense

OBJECTIVE: Build a sensor for detecting biological warfare agents and simulants using Nuclear Quadrupole Resonance (NQR) Spectroscopy. Such a system would be capable of detecting concealed BW agents in a closed suitcase or buried below the ground.

DESCRIPTION: Nuclear Quadrupole Resonance (NQR) has been used for detection of explosives, narcotics, and buried landmines. Commercial NQR detection systems are now beginning to appear in Airport Security systems for detection of explosives, narcotics, and other contraband. Typically in these applications, the NQR signal of a nitrogen-14 atom in an unusual molecular configuration is detected. All compounds that contain nitrogen-14 have Nuclear Quadrupole Resonance absorption bands in the region of 0.2 MHz to 5.0 MHz. Electromagnetic radiation in this region can easily see through a suitcase to look for contraband or look below the surface of the ground for buried landmines. Dipicolinic acid (2,6-pyridinedicarboxylic acid, C5H3N(COOH)2) is a major constituent of the bacterial spores that make up many BW agents. In some cases, calcium dipicolinate constitutes up to 17% of the dry weight of the spores. Dipicolinic acid, or DPA for short, is believed to be an important contributor to the resistance of spores to both heat and UV radiation. The material also appears to be important in spore stability and spore germination. The dipicolinate ion has a nitrogen atom in a benzene ring and has a distinctive Nuclear Quadrupole Resonance (NQR) signal. The NQR signatures of dipicolinate have been predicted to lie somewhere between 3.0 and 5.0 MHz. “Dipicolinate is almost unique to bacterial spores, and it may constitute as much as 15% of their weight.” Page 47, Microbiology, Davis, Dulbecco, Eisen, Ginsberg, Fourth Edition, 1990, J.B. Lippincott.

PHASE I: Demonstrate laboratory scale a proof-of-concept NQR system capable of detection of bacterial spores. The proof-of-concept system shall be able to detect small (less than ten grams) quantities of the BW simulant Bacillus Subtilis using the distinctive NQR signature of the bacterial spores. Determine the resonance frequencies for Calcium Dipicolinate and also for Bacillus Subtilis.

PHASE II: Build a prototype of an NQR system for detecting BW agents in a closed container such as a suitcase. Demonstrate detection of small quantities (less than ten grams) of Bacillus Subtilis in a closed and locked suitcase.

PHASE III DUAL USE APPLICATIONS: Conduct a feasibility study of modifying existing contraband detection systems in airports based on NQR spectroscopy to provide additional protection against BW agents shipped in closed containers such as a locked suitcase.

OPERATING AND SUPPORT COST REDUCTION: NQR contraband and explosive detectors are currently in use at commercial airports. These sensors are saving a fortune by providing Airport security in a manner that is fast and non-intrusive. Such cost savings could also be extended to providing protection against BW agents.

KEY WORDS: BW Agents, Airport Security, Domestic Preparedness, NQR, Nuclear Quadrupole Resonance.

REFERENCES :
1. J.A.S Smith, “Nuclear Quadrupole Resonance Spectroscopy – General Principles”, Journal of Chemical Education, Volume 48, Number 1, Pages 39-49, 1971.
2. M.D. Rowe and J.A.S. Smith, "Mine Detection by Nuclear Quadrupole Resonance", Eur96, Page 62, 1996.
3. S. H. Pendukar and P. R. Kulkarni, “Chemical Composition of Bacillus Spores”, Die Nahrung, Vol 32, Page 1003, 1988.
4. H. Halvorson and C. Howitt, "Spores II”, edited by H. O. Halvorson, Page 149, Burgess Publishing Co., Minneapolis, MN (1961).
5. G. W. Gould and A. Hurst, "The Bacterial Spore", Academic Press, London (1969).

CBD00-104 TITLE: CB Water Monitor Biological Concentration

TECHNOLOGY AREAS: Chemical/Biological Defense

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PM, Nuclear, Biological, & Chemical Defense System

OBJECTIVE: Build a hand held system to collect, concentrate, and isolate biological agents from source, treated, stored, and distributed water supplies. The extracted agents will be presented to varying detection systems (see Topic Number CBD00-105). Analytes include bacterial cells, spores, cysts, viruses, and toxins. Novel methods to extract genetic material, including DNA and mRNA are also desired.

DESCRIPTION: The Joint Service Agent Water Monitor (see Topic Number CBD00-105) will require sample collection, concentration, and extraction of biological analytes such as bacterial cells, spores, cysts, viruses, and toxins. No detection technology has been found that can detect to the trace levels required and accommodate the widely varying background waters (source, treated, stored/distributed) that will be monitored. Target analytes may be diluted in large volumes of water (thousands of gallons), the water may be turbid (such as natural waters), it is likely the background of the water will not be favorable to a particular sensor technology. This is especially true for natural water samples. This pre-processing is seen as a separate technology “module” in the JSAWM system and is therefore solicited as a separate topic. After a sample has been collected, concentrated, and extracted, it can be passed to a number of competing and/or complementary detection technologies. The Objective of the JSAWM program is to develop a hand held sensor to detect, identify, and quantify CB agents in water supplies. The pre-concentration module should fit within this format. Size, weight, power requirements are a consideration. We have not found this capability in the commercial market. This is an R&D effort involving a degree of technical risk.

PHASE I: Contractor will demonstrate proof of principle operation based on 20 gallon challenges. The 20 gallon aliquots will have varying concentrations and composition. The system can be a laboratory set-up, but should be man-portable.

PHASE II: Contractor will build a prototype system to be field tested. This will involve tests where the new monitors are placed in-line in real and simulated water lines for testing.

PHASE III DUAL USE APPLICATIONS: The proposed pre-processing system would have immediate applications in monitoring municipal and commercial water supplies for possible contamination by biological contaminants.

OPERATING AND SUPPORT COST (OSCR) REDUCTIONS: There is currently no method to extract, concentrate, and isolate trace levels of biological agents from thousands of gallons of water.

KEYWORDS: water, source, treated, distributed, potable, pre-concentration, extraction, isolation, biological, agents, bacteria, spores, cysts, viruses, toxins, parasites.

REFERENCES:
1. Joint Chemical/Biological Agent Water Monitor (JCBAWM) Operational Requirement Document (ORD), 1997.
2. Eaton, Andrew D, Lenore S. Clesceri, Arnold E. Greenberg, Standard Methods for the Examination of Water and Wastewater, 19th Edition. American Public Health Association, Inc., New York, 1995.
3. Hurst, Christon J., et al, Manual of Environmental Microbiology; ASM Press, Washington, D.C., 1997.
4. Abbaszadegan, Morteza, Peter W. Stewart, Mark W. LeChevallier, Charles P. Gerba, Application of PCR Technologies for Virus Detection in Groundwater, AWWA Research Foundation and American Water Works Association, 1998.
5. Kaffka, Alexander V., Sea Dumped Chemical Weapons: Aspects, Problems, and Solutions, Kluwer Academic Publishers, Norwll MA, 1996.
6. Nikolelis, Dimitrios P., Ulrich J. Drull, Joseph Wang, and Marco Mascini, Biosensors for Direct Monitoring of Environmental Pollutants in Field, Kluwer Academic Publishers, Norwll MA, 1997.
7. Ingle, Jr., James D., Stanley R. Crouch, Spectrochemical Analysis, Prentice-Hall, Inc., New Jersey, 1988.
8. The Incidence, Monitoring, and Treatment of Viruses in Water Supply Systems – A State of the Art Review, Environmental Engineering Division, American Society of Civil Engineers, New York, 1983.
9. Vanderzant, Carl, Don F. Splittstoesser, Compendium of Methods for the Microbiological Examination of Foods, Third Edition, American Public Health Association, 1992.

10. McFeters, Gordon A., Drinking Water Microbiology, Springer-Verlag, New York, 1990.
11. Pawliszyn, Janusz, Solid Phase Microextraction Theory and Practice, Wiley-VCH, New York, 1997.
12. Ward, Robert C., Jim C. Loftis, Graham B. McBride, Design of Water Quality Monitoring Systems, Van Nostrand Reinhold, New York, 1990.
13. Colin, F., P. Quevauviller, Monitoring of Water Quality, The contribution of advanced technologies, International Water Centre, Elsevier, New York, 1998.
14. Gustafson, David I., Pesticides in Drinking Water, Van Nostrand Reinhold, New York, 1993.
15. Patel, P., Rapid Analysis Techniques in Food Microbiology, Blackie Academic & Professional, 1994.

CBD00-105 TITLE: Chemical and Biological Water Monitor

TECHNOLOGY AREAS: Chemical/Biological Defense

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PM, Nuclear, Biological, & Chemical Defense System

OBJECTIVE: Develop a hand held, real time sensor system that can detect, identify, and quantify chemical and biological agents in water supplies. Power, size, and weight are considerations. Both in-line and batch monitoring are desired. Time to detection sought is 10 minutes. Water supplies include point source, treated, stored and distributed waters. Sensor system will provide early warning of contamination or possible attack.

DESCRIPTION: There is an immediate need for the ability to detect, identify, and quantify chemical and biological (CB) agents in water supplies during water point selection, production, storage, and distribution to consumers (including shower points and personnel decontamination stations). Water point selection can be natural waters such as lakes, rivers, streams, reservoirs, municipal waters. Production water is field/shipboard treated water. Stored and distributed water can be treated field water, bottled water, and locally purchased water that is trucked or piped to military storage (field and ship). Chemical Detection is required to parts per trillion levels by class, such as nerve, blister, and blood.

Biological detection by class is considered to be bacteria, virus, toxin, parasite and pathogenic versus non-pathogenic. The trace levels of detection required are considered problematic. A call has been made for technologies in “CBD00-104 Water Contamination Concentration” to concentrate and extract dilute analytes from water. Detection technologies that can do the detection, identification, and/or quantification without such pre-processing are highly desirable.

PHASE I: Contractor shall propose and design a system to detect, identify, and quantify chemical and/or biological agents in water. The main goal of Phase I will be a proof of principle demonstration based on a Government furnished test matrix. The Contractor and the Government will agree on the test matrix before testing. The “proof of principle” system can be a laboratory breadboard. Emphasis is placed on technologies that are innovative and creative. The final system (not necessarily the Phase I system) is expected to be a hand held device. Deliverable is a report and test data.

PHASE II: Contractor will build a hand held developmental prototype. Developmental prototypes do not have to be field hardened. The goal of Phase II will be demonstration and delivery of the system to the Government. The Government will test the system. This will involve tests where the new monitors are placed in-line in real and simulated water lines for testing.

PHASE III DUAL USE APPLICATIONS: The current estimated requirement is 20,000 fielded units for Joint Service use. Successful candidates will be added to the JSAWM as a “technology module”. The JSAWM concept is a modular system analogous to current day computers. Peripheral devices can be added and removed by the user as needed. Additional applications exist in other DoD and government agencies such as Medical, Domestic Preparedness, Demilitarization, Treaty Verification. JSAWM has been working closely with CEHR where a medical requirement for water monitoring exists. Although JSAWM and CEHR requirements have striking differences, we are working together to leverage technologies and programs where possible. In addition, the proposed water monitor would have immediate application in monitoring municipal, commercial, and recreational water supplies. The EPA has funded two non-profit organizations in the past two years to search for advanced warning and early monitoring technologies for water contamination. At the recent ILSI Risk Institute Workshop (May 1999, Reston, VA), a number of public water managers, CDC, and EPA addressed the concern and need for early warning monitoring of public water. The EPA has an immediate need for early warning monitoring of recreational water.

OPERATING AND SUPPORT COST (OSCR) REDUCTIONS: Current water monitoring systems require numerous reagents and are time and labor intensive. The JSAWM program is seeking and/or developing technologies that can detect in less than or equal to 10 minutes for chemical and biological analytes with minimal attendance, maintenance, logistics, and cost.

KEYWORDS: early warning, rapid, potable, source, stored, distributed, water, monitoring, potable, chemical, biological, in-line monitor, water treatment quality assurance.

REFERENCES:
1. Joint Chemical/Biological Agent Water Monitor (JCBAWM) Operational Requirement Document (ORD), 1997.
2. Eaton, Andrew D, Lenore S. Clesceri, Arnold E. Greenberg, Standard Methods for the Examination of Water and Wastewater, 19th Edition. American Public Health Association, Inc., New York, 1995.
3. Hurst, Christon J., et al, Manual of Environmental Microbiology; ASM Press, Washington, D.C., 1997.
4. Abbaszadegan, Morteza, Peter W. Stewart, Mark W. LeChevallier, Charles P. Gerba, Application of PCR Technologies for Virus Detection in Groundwater, AWWA Research Foundation and American Water Works Association, 1998.
5. Kaffka, Alexander V., Sea Dumped Chemical Weapons: Aspects, Problems, and Solutions, Kluwer Academic Publishers, Norwll MA, 1996.
6. Nikolelis, Dimitrios P., Ulrich J. Drull, Joseph Wang, and Marco Mascini, Biosensors for Direct Monitoring of Environmental Pollutants in Field, Kluwer Academic Publishers, Norwll MA, 1997.
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CBD00-106 TITLE: Development of a Miniaturized Biological Detector

TECHNOLOGY AREAS: Chemical/Biological Defense

OBJECTIVE: Develop a miniaturize Biological detector that can be either scattered on the battlefield for early warning or warn by the soldier on his / her lapel.

DESCRIPTION: The Edgewood Chemical and Biological Center (ECBC) is developing a number of biological agent's detectors. All the detectors that are currently under development are large, heavy, and require expertise in their operation. Some detectors that are in development are "brief case" size, but require a separate sampler for collecting the particles from the air and introducing them to the detector.

In recent years great progress had been made in the micro machining / nano technology area. The purpose of this effort is to apply this emerging technology for developing a miniaturized biological detector that will include a miniaturized aerosol sampler / collector and detection device, a miniaturized GPS and a miniaturized communication system. The detector can be either a general biological detector or detectors for a specific agents. In the first case multiple miniaturized detectors could be scattered on the battlefield and act as an early warning system by networking them. In the second case the detector will be worn by the individual soldier and alert him / her, and the medics, when he or she was exposed to the specific agents. This will greatly facilitate treatment. In addition, the detector will be able to detect when the soldier is being exposed to a locally endemic biological material. This is necessary as the involvement of US in various missions around the world is expected to expand and as more and more emphasis is being placed on preserving the health of the soldier, following the Gulf War Syndrome. The detector should be able to operate for a as a stand alone device for a period of at least 48 hours unattended operation, stay in constant communication with the home base and store the data (including GPS data and time/date) for that period.

PHASE I: Demonstrate the technology and design and build a prototype detector. Test the ability of the detector to sample the air, detect when biological aerosols above a preset threshold level are present, and communicate its finding. The deliverable from phase I will be the prototype detector and the various documentation required to further develop the technology and proceed to phase II.

PHASE II: Further develop the technology to the point were it can be mass-produced at a reasonable cost and demonstrate it in chamber and field trials. The demonstration should include the ability of the detector to detect generic biological aerosols and a specific biological aerosol.

PHASE III DUAL USE APPLICATIONS: In its military application the detector can be used as an early warning system when scattered on the battlefield ahead of the troops (Army and Marines) around an airfield (Airforce) or a port (Navy). Another potential military use is to fly the miniaturized detector into a suspicious cloud, or drop it by a parachute into the cloud to identify the nature of the cloud and determine if it can present a hazard to the troops. The technology developed under this SBIR can be transferred to the health industry, the environmental protection arena and to the industrial hygiene area. A miniaturizes biological agent detector can be used by health care providers to monitor the spread of infectious diseases and by individual health providers to detect when they were exposed to an infectious organism. In the environmental protection arena it will enable the EPA to quickly identify the cause of “sick building”. Industrial hygienists will be able to use the device to monitor and control the exposure of workers to harmful organisms.

OPERATING AND SUPPORT COST (OSCR) REDUCTION: Miniaturization technology took off during the past few years and is expected to develop quickly. Mimicking the development of microelectronics, mass production cost can be expected to decline quickly. It is expected that once developed a mass produced detector could cost several hundreds dollars vs. tens of thousands of dollars to produce a detector based on conventional technology.

KEYWORDS: Biological detectors, Biological agents, miniaturization.

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CBD00-107 TITLE: Development of a Miniaturized Chemical Detector

TECHNOLOGY AREAS: Chemical/Biological Defense

OBJECTIVE: Develop a miniaturize Chemical detector that can be either scattered on the battlefield for early warning or warn by the soldier on his / her lapel.

DESCRIPTION: The Edgewood Chemical and Biological Center (ECBC) fielded and is developing a number of chemical agent’s detectors. All the detectors that had been fielded or, are currently under development, are large, heavy, and require expertise in their operation. Several detectors are handheld. DARPA as well as the Navy are sponsoring several programs to develop miniaturized chemical detectors (Canadian Commercial Corp, University of North Texas). A “chemistry lab on a chip” is currently being reported by ORNL . The purpose of this effort is to develop a miniaturized chemical detector that will include a miniaturized sampler / collector and detection device, a miniaturized GPS and a miniaturized communication system. The detector should be able to detect all the common chemical warfare agents at a sub effect level. The detector should also be able to operate in a collection mode. In that mode it should be able to collect volatile and semi-volatile vapors for later analysis. In the first case multiple miniaturized detectors could be scattered on the battlefield and act as an early warning system by networking them. In the second case the detector will be worn by the individual soldier and alert him / her, and the medics, when he or she was exposed to the specific agents. This will greatly facilitate treatment and provide better situational awareness to the commander. In its collection mode the detector will provide information were the soldier has been and to what harmful vapors (including industrial effluents) he or she had been exposed. This is necessary as the involvement of US in various missions around the world is expected to expand and as more and more emphasis is being placed on preserving the health of the soldier, following the Gulf War Syndrome. The detector should be able to operate for a as a stand alone device for a period of at least 48 hours unattended operation, stay in constant communication with the home base and store the data (including GPS data and time/date) for that period. Other operational possibility is to mount the detector on a UAV for damage assessment following destruction of suspected of production or storage sites in hostile territory.

PHASE I: Demonstrate the technology and design and build a prototype detector. Test the ability of the detector to sample the air and detect when chemical agents are present. The deliverable from phase I will be the prototype detector and the various documentation required to further develop the technology and proceed to phase II.

PHASE II: Further develop the technology to the point were it can be mass-produced at a reasonable cost and demonstrate it in chamber and field trials. The demonstration should include the ability of the detector to detect chemical agents and collect semi volatile and volatile vapors that can later could be analyzed given standard analytical methods.

PHASE III DUAL USE APPLICATIONS: In its military application the detector can be used as an early warning system when scattered on the battlefield ahead of the troops (Army and Marines) around an airfield (Airforce) or a port (Navy. The technology developed under this SBIR can be transferred to the environmental protection arena and to the industrial hygiene area. In the environmental protection arena it will enable the EPA to quickly identify the cause of "sick building" and identify effluent from hazardous waste sites. Industrial hygienists will be able to use the device to monitor and control the exposure of workers to harmful chemicals.

OPERATING AND SUPPORT COST (OSCR) REDUCTION: Miniaturization technology took off during the past few years and is expected to develop quickly. Mimicking the development of microelectronics, mass production cost can be expected to decline quickly. It is expected that once developed a mass produced detector could cost several hundreds dollars vs. tens of thousands of dollars to produce a detector based on conventional technology.

KEYWORDS: Chemical detectors, Chemical agents, miniaturization.

REFERENCES:
1. Kenning, Vanessa M.; Call, Charles J.; Call, Patrick T.; Birmingham, Joseph G.; "Collection of airborne bacteria with micro-machined virtual impactor Arrays" Proceedings of the 1998 ASME International Mechanical Engineering Congress and Exposition, Anaheim, CA Nov 1998.
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CBD00-108 TITLE: Chemical Immobilizing Agents for Non-lethal Applications

TECHNOLOGY AREAS: Chemical/Biological Defense, Weapons

OBJECTIVE: To demonstrate the feasibility of a safe, reliable chemical immobilizing agent(s) for non-lethal (NL) applications in appropriate military missions and law enforcement situations.

DESCRIPTION: Previously developed or proposed incapacitating or immobilizing agents have been deficient in one or more technical aspects. These deficiencies include low safety ratios and inadequate performance characteristics, such as, reliability of desired response, onset time to effects and duration of effects. Recent pharmaceutical developments suggest that new approaches to safer Chemical immobilizers with improved performance characteristics may be available. The Joint Non Lethal Weapons Directorate, Quantico, VA is the executive agent for Non Lethal technologies. Discussions with the JNLWD indicate that this technology falls under their broad core mission area of "incapacitating personnel" and could be used in specific areas such as "clearing of facilities" and "area denial".

PHASE I: Assess route of entry of potential immobilizing agents through coordination with the User. The route of entry is key since it affects safety/efficacy issues, onset time to effect and delivery technique. Conduct an analysis of promising new chemical immobilizing agents or combinations of agents. The analysis of this area will include recent breakthroughs in the pharmacological classes such as Anesthetics/analgesics, tranquilizers, hypnotics and neuromuscular blockers. Select the most promising new approaches/immobilizing agents. Review existing data to identify gaps for proposed use. Design and conduct a toxicological test program with these new immobilizing agents to fill data gaps. Establish the mode of immobilization, the effective dose(age) for immobilization, onset time and duration of effects, and safety ratio in the most appropriate animal species. Correlate these new experimental results with existing data, if any, from other studies, especially in humans (clinical tests) and non-human primates to establish feasibility of use for non-lethal applications.

PHASE II: Establish desired performance/operational characteristics versus potential scenarios of use. Solicit comprehensive input from potential users, such as, Special Operations Forces; Military Police; and other service support through the Joint Non Lethal Weapons Directorate; Department of Justice (FBI and National Institute of Justice) agencies; and state and local law enforcement representatives. Determine implications of the Chemical Warfare Convention (CWC) for proposed scenarios of use. Select optimum scenario(s) of use. Design and conduct non-human primate and clinical tests to establish safety and performance characteristics. Design and conduct ancillary toxicological tests to address environmental and similar concerns. Design and demonstrate an appropriate delivery technique for example; an aerosol generator for dissemination for the inhalation route of entry, or a dart for injection in the intra-muscular route of entry.

PHASE III DUAL USE APPLICATIONS: Potential military uses include Meeting US and NATO objectives in peacekeeping missions; crowd control; embassy protection; rescue missions; and counter-terrorism. For many years the Department of Justice has been interested in alternate non-lethal (or less-than-lethal (LTL)) technology for law enforcement. For example, the 1986 Attorney General's Conference on Less-Than-Lethal Weapons included a plenary briefing and a workshop session on LTL chemical agents. The interest in developing LTL alternatives to guns and bullets and clubs remains today. Potential applications include: use by local, state and national law enforcement agencies, for example, FBI, Alcohol Tobacco Firearms (ATF) and state and local police, in hostage and barricade situations; crowd control; close proximity encounters, such as, domestic disturbances, bar fights and stopped motorists; to halt fleeing felons; and prison riots.

KEYWORDS: immobilizing agents, incapacitating agents (incaps), less-than-lethal (LTL) agents, non-lethal (NL) agents, Riot Control Agents (RCA), Advanced Riot Control Devices (ARCAD).

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CBD00-109 TITLE: <u>Biological Warfare Agent (BWA) Deactivating Textile Systems for Chemical/Biological (CB) Protection</u>

TECHNOLOGY AREAS: Chemical/Biological Defense

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PM Soldier

OBJECTIVE: To develop nanofiber and/or air-permeable microporous membranes containing sub-micron BWA deactivating particles for CB protective clothing applications via coatings and semipermeable membrane loading technologies.

DESCRIPTION: Current air-permeable, activated carbon based chemical protective (CP) clothing provides good chemical agent protection against vapor and liquid challenges. However, their fabric structures are susceptible to penetration by small aerosol particulates. These aerosols can be used to carry viruses, bacteria, toxins, and health-hazardous insecticides such as organophosphates. A vaccine has been developed and shown to be effective against Anthrax. However, protective clothing has been determined as necessary in providing supplemental protection against Anthrax and other viral/bacterial percutaneous threats such as T2 Mycotoxin.1 Air-permeable microporous membranes and electrospun nanofiber webs have demonstrated 99.9% aerosol efficiency while maintaining desirable moisture vapor transmission rates. However, BWA contained in/on these aerosols could potentially be airborn again through the wearer's movements and can harm others who are not in protective clothing. The user is also susceptible during the garment doffing procedure. Furthermore, although a healthy skin has been viewed as an excellent barrier to biological agent threats, there is a high probability on the battlefield that soldiers will have skin scratches and wounds in conducting their various missions. These skin scratches and wounds represent pathways to BWA infection. This topic calls for the investigation of commercially available BWA threat deactivating materials2 (e.g., biocides with metallic oxides or halide functional end-groups) and the development of new nanofiber or microporous membranes that contain these biocidal materials. The use of these new membranes could be an effective way to supplement the capability of permeable CP clothing with minimal sacrifice in comfort via evaporative cooling.

PHASE I: Identify effective BWA deactivating materials and membrane carriers via laboratory demonstration of biocidal activity toward Bacillus subtilis and Bacillus Thuringienises. These are spore-forming bacterial surrogates to Anthrax. Specific test protocols3 and test criteria will be provided. Performance testing and evaluation of multilayer membrane/fabric samples will also be conducted in consultation and/or participation of the US Army Medical Research Command. These tests will measure the deactivation of biological aerosol surrogates (Bacillus subtilis and Bacillus Thuringienises, and/or others), aerosol and liquid resistance, (and chemical agent simulant vapor efficiency as combined with carbon-based permeable fabrics). Show the feasibility for protective clothing applications.

PHASE II: Optimize BWA deactivating material loading process onto microporous and/or nanofiber membranes. Scale up laboratory membrane production to pilot scale process. Investigate clothing fabrication processes that include loading of BWA deactivating particles. Provide material samples and prototype clothing deliverables, and participate in US Army laboratory testing and evaluation, and prototype ensemble fabrication for system testing of its effectiveness against biological agent surrogates and also chemical agent simulants (as used with other chemical protective materials.)

PHASE III DUAL-USE APPLICATIONS: Dual use applications include HAZMAT and environmental clean-up, counter-terrorism, law-enforcement, industrial applications, individual protection from blood-born pathogens, CB protective breathing/gas masks, aerosol protective filters, air stream and liquid cleaning systems.

KEYWORDS: CB warfare agents, nanofiber membranes, air-permeable microporous membrane, CB agent protective clothing, biocides, self-deactivation, and BWA protective membranes.

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CBD00-110 TITLE: Chemical Protective Gloves with Enhanced Properties

TECHNOLOGY AREAS: Chemical/Biological Defense

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PM Soldier

OBJECTIVE: Explore nanoscale phenomena to develop novel materials and a nonpolluting process for the manufacture of tactile, durable, flame retardant, solvent resistant gloves impermeable to liquid chemical warfare (CW) agents.

DESCRIPTION: The 7-, 14-, and 25-mil-thick chemical protective gloves currently used by the military are made of butyl rubber reinforced with carbon black [1]. They are produced by an organic-solvent, dipping process. The gloves are neither resistant to petroleum-type solvents, oils and lubricants nor to flames. However, they show excellent resistance to liquid CW agents and to oxygenated-type solvents. With the incorporation of inorganic nanoparticles into select polymers, it may be possible to improve their resistance to CW agents and at the same time take advantage of their other features, such as good resistance to solvents, abrasion and aging. It has been shown that inorganic nanoparticles dispersed in a polymeric matrix have a tendency to form layers through its thickness, thus enhance barrier properties of polymers [2]. Moreover, the inorganic nature of these nanoparticles and their intumescent properties may impart flame resistance and thus eliminate the need for adding flame retardant chemicals into formulations [3]. Furthermore, these new materials should be amenable to nonpolluting processing techniques, such as injection molding, blow molding, spraying/sintering, or aqueous/emulsion dipping.

PHASE I: Select candidate polymers and fabricate glove materials in the laboratory. Determine pertinent physical and mechanical properties, and also resistance to permeation by CW agents.

PHASE II: Optimize the best candidate materials selected in Phase I. Develop a cost-effective, nonpolluting process for the manufacture of gloves. Produce gloves in 7-, 14- and 25-mil thicknesses for laboratory testing and field evaluation.

PHASE III: Butyl gloves are widely used in industrial applications. Improvements either in properties of materials, such as flame retardancy and abrasion resistance, or process, which would lower the volatile organic compounds (VOC) content, will readily find commercial acceptance. Other potential commercial applications for materials containing nanoparticles include coatings for tentage and for special purpose protective suits needed for domestic preparedness activities.

OPERATING AND SUPPORT COST REDUCTION (OSCR): Since there are vastly more companies that produce gloves by an emulsion process than by an organic-solvent dipping process, any new material which can be produced by the former would greatly facilitate procurement of these items for the military, resulting in more competitive pricing. Also, this topic offers an opportunity for a significant reduction in VOC releases by employing nonpolluting process operations.

KEYWORDS: gloves, elastomers, polymers, nanomaterials, nanoparticles, chemical protection.

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CBD00-111 TITLE: Development of Enhanced Chemical Biological (CB) Closure

TECHNOLOGY AREAS: Chemical/Biological Defense

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PM Soldier

OBJECTIVE: To develop miniaturized CB / water-tight separating closure

DESCRIPTION: Recently developed CB uniforms incorporate state-of-the–art seam-tapeable light-weight materials offering complete protection from direct liquid, vapor and aerosol exposure. All CB suits are evaluated in final design for 'Man In Simulate Testing' (MIST). The front entry closure system has been water-tight closures from the commercial dry-suit market. However, although these closures pass evaluation of MIST, they are incompatible with the uniform since they are for heavy-duty application. Consequently, these closures possess a slider resistance that is extremely high (enough to rip the outershell fabric). The closure tape stiffness overwhelms the CP uniform outershell fabric and due the extreme thickness of the closure tape, it is difficult to seam-tape and in some cases the seam-tape fails to stick properly. Furthermore, these closures are costly at about $1. per inch.

Ongoing Trust: The primary thrust of this proposal is tied to the development of a mutiservice Army / Navy 'Waterproof CB Resistant Closure Suit' which incorporates a selected lightweight permeable membrane that does not use carbon base coating. Purpose of suit is to reduce weight, increase flexibility, provide seam tapeability and be breathable, however the suit shall be totally waterproof including closures. The suit has been using a commercially available dry-suit diving closure. However, this zipper totally overwhelms the base lightweight outershell fabric of the CB uniform since they are hard to open / close, very stiff due to there extreme thickness, difficult to vacuum package due to stiffness and uncomfortable to wear, but they do pass all CB protection requirements. Purpose of this SBIR is to develop a miniaturized version of this closure as to reduce cost, improve seam tapeability, flexibility, comfort, donning/doffing, packing size and weight without sacrifice to CB protection.

PHASE 1: Overall requirements for proposed SBIR would be to provide for a miniaturized water-tight closure in a commercial size range of 2-6 (small-medium) with a significantly reduced cost. The minimum chain crosswise strength shall be 145 lbs, offer resistance to liquid, as well as vapor chemicals, in closed state and be hydrostatic resistant at 50 cm. for 10 min. period in both a relaxed and in a 5 lb. crosspull mode of the opposite tape sides. Slider pull strength shall offer 2.0 pound (max.) slider resistance, be available in separating configuration, and use a lightweight highly flexible closure tape that offers a seam-tapeability at 5 lb. (min.) peel resistance. Design for Phase 1 shall incorporate use of single slider in conjunction with a means to separate the closure (pin & box, etc). Technical barriers include design of separating unit, lower pull resistance, selection of materials to offer CB resistance and yet be seam tapeable.

PHASE 2: Finish with addition of second slider in a mouth to mouth arrangement, other concepts and develop manufacturing equipment for large scale production of miniaturized closure. The closure shall be applied to field testing of new generation CB uniforms, rainwear, CB / general field tentage, equipage, tarps (weapon covers), underwater usage or other end-items.

POTENTIAL COMMERCIAL MARKET: Closures shall be used on array of commercial tentage, equipage, wet / dry suits, truck / boat covers, nuclear suits, tarps, bags or other protective applications.

KEYWORDS: closure, chemical biological

CBD00-112 TITLE: Development Of Two Phase Multivaccine Delivery System With Protective and Bioadhesive Properties For Oral Immunization.

TECHNOLOGY AREAS: Chemical/Biological Defense, Biomedical

OBJECTIVE: Design, produce and evaluate a two phase controlled vaccine delivery system for oral immunization, which is capable of protecting the incorporated immunogen in the stomach, and provide maximized release in the colon by bioadherence. In its final form the delivery system should accommodate up to for different immunogens, and should provide full protection for one year against aerosol-delivered the highest possible respective challenge level
in appropriate animal host. The estimated time of the preclinical development and full evaluation of the carrier system for orally administered vaccines is 3 years.

DESCRIPTION: Oral administration of peptides, proteins and vaccines requires incorporation into a biodegradable primary carrier with controlled release- rate property. The primary carrier should be enclosed in a secondary
biodegradable carrier which is capable of protecting the primary carrier/vaccine complex against the adverse conditions of the stomach. For maximized increased bioavalability of the vaccine, the primary carrier matrix should display bioadhesive properties toward mucosal membranes.

PHASE I of the development entails identification of the primary and the secondary carrier system for the release of the recombinant protective antigen of anthrax vaccine, and in vivo evaluation of the system in proper animal model. To achieve single immunization which will provide full protection for one year against anthrax challenge, the incorporated vaccine should stimulate two-three distinct antibody peaks with several weeks of intervals between the peaks. If required, a mucosal adjuvant should be incorporated separately into the primary carrier to help enhance the humoral immune response by synchronized release of the vaccine and the adjuvant. The encapsulation efficacy should not be below 80% of the vaccine input, and the core-loading should not be below 1%-2%.

PHASE II of the development entails application of the two phase delivery system to vaccines which protect against plague and Q fever and a vaccine against emerging threat identified prior to Phase II. Phase II will include development of prototype carrier system containing 3-4 vaccines which will provide full protection in their respective animal model for at least one year against aerosol-delivered highest possible challenge level. If needed, mucosal adjuvant should be included in the prototype two-phase delivery system.

Phase III will entail safety studies and production scale-up of a large batch sufficient for human trials conditioned on IND approval.

KEY WORDS: primary bioadhesive carrier, secondary protective carrier, oral immunization, single dose, mucosal adjuvant, long-term protection, multivaccine two-phase carrier system.

CBD00-113 TITLE: Development Of Human Skin Model For Sulfur Mustard Research

TECHNOLOGY AREAS: Chemical/Biological Defense

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: Medical Research and Materiel Command

OBJECTIVE: To acquire a full thickness or partial thickness (epidermal) human skin model for in vitro cultivation that can be used in biomedical research of the sulfur mustard (HD) injury.

DESCRIPTION: Morphopathologic data of HD dermal toxicity has been gathered largely in controlled animal investigations and in cultured human monotypic cells. However animal models typically do not manifest the full formation of fluid-filled surface bullae found with human exposure and cultured monotypic cells do not provide information on the involvement of the dermal-epidermal junction. Our requirements for the development of a full thickness or partial thickness (epidermal) in vitro human skin model for HD study is based upon the need for an in vitro skin model which would relax dependence on animals for repetitive screening studies and would more closely simulate typical human dermal responses to HD.

PHASE I: The following are requirements of the skin model:

1. Morphologically must possess in vivo counterparts of interest to the research mission such as components of a true basement membrane, hemidesmosomes, basal cell adherent mechanisms, desmosomes, epithelial stratification, evidence of cellular differentiation to include the generation of a stratum corneum.
2. Immunohistochemically should express dermal proteins of interest to the research mission such as laminin, collagens (Types IV, III, VII), bullous pemphigoid antigen BPA (1 and 2), keratin, fibronectin, desmosomal, GB3 (anchoring filament protein), integrins (alpha 6 beta 4).
3. The model must be configured to accept HD vapor cup as well as liquid exposures. The typical vapor cup used for vapor exposures is 12-14 mm.

The product in this phase will be subjected to light microscopic, ultrastructural and immunohistochemical study for verifications of the above considerations.

PHASE II: The product in this phase will be subjected to exposures to HD. The consequences of the exposure will be explored by morphological and immunohistochemical study. Special attention will be given to induced processes of apoptosis-vs-oncosis as evidenced by the elaboration of specific epithelial markers such as Bcl -2, P53, and tunel staining (DNA nicks). In addition the product will used for screening of candidate HD prophylactic and therapeutic compounds.

PHASE III DUAL USE APPLICATIONS: The product in this phase may have potential for drug screening by cosmetic and pharmaceutical companies.

KEY WORDS: Skin model, human skin equivalent, basement membrane zone, adhesion molecules, sulfur mustard, HD.

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CBD00-114 TITLE: Chemical Destruction of Chemical Warfare Agents and Toxic Materials in a Mobile Solvent-free Reactor

TECHNOLOGY AREAS: Chemical/Biological Defense, Materials/Processes, Weapons

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PM, Non-Stockpile Chemical Material

OBJECTIVE: To develop a metal oxide solvent-free system utilizing chemical reactivity to neutralize chemical warfare agents and toxic materials. The system will be compact, mobile, and based on a reactive chemistry that includes components widely available and easily transported.

DESCRIPTION: Advances in metal oxide chemistry have shown that nanoparticulate metal oxides can be utilized for the destruction of chemical warfare agents and toxic materials of concern to the DoD and industry.1-3 For example magnesium oxide nanoparticles have enhanced reactivity due to the larger surface area of the nanoparticles and the larger number of active edge sites.4 Their reactivity arises from direct oxidation and hydrolysis of materials and thus is a solvent free chemical reaction. The potential exists to utilize these oxide nanoparticles in a solvent-free reactor for the destruction of toxic materials or chemical agents. During wartime activities or otherwise containers or shells of chemical agent may be encountered on the battlefield or training grounds. Neutralization before relocation is the preferred method of dealing with the unwanted and possibly dangerous materials. Metal oxide chemistry shows promise as a solvent-free system for neutralization of toxic agents. The reactor developed should fully neutralize the chemical agent or toxic material under a variety of conditions of humidity, temperature, and material purity. Complete neutralization of the chemical agent includes utilizing minimal amounts of metal oxide particles. The reactor should be capable of neutralizing 4-8 L batches of material and be readily transported by a small truck.

PHASE I: Phase I will include the identification of the ideal metal oxide and development of optimum reaction conditions including temperature, concentration, and reaction time of a metal oxide destruction system. Phase I will also include design of a reactor that will utilize the system developed. A method for determining if the materials have been destroyed in the reactor should be considered at this point.

PHASE II: Phase II will focus on engineering a prototype reactor and determining the key parameters for efficient operation utilizing the metal oxide system developed in Phase I. Live agent testing should be included in the Phase II testing of the metal oxide system and reactor.

PHASE III DUAL USE APPLICATIONS: Phase III includes development of a deployable reactor for chemical warfare agents or toxic materials and initiation of the process of gaining approval for use with hazardous materials. This reactor is of interest to the non-stockpile chemical demilitarization program or battlefield destruction of chemical agent confiscated from opponents. Dual use application includes the utilization of the system for the destruction of small batches of industrial compounds that might not be readily transported to another site.

KEYWORDS: decontamination, chemical warfare agents, toxic industrial chemicals, metal oxides, demilitarization, deployable

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Navy CBD Topics

CBD00-201 TITLE: Chemical/Biological Sensor for Munitions

TECHNOLOGY AREAS: Chemical/Biological Defense, Weapons

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: MARCOR SYSCOM, PM: Combat Support & Logistics Equipment/Nuclear Biological Chemical

OBJECTIVE: Develop chemical/biological sensor system that is robust and small enough to be used as payload in an artillery projectile.

DESCRIPTION: There is no remote CB sensor that can be deployed from a ship prior to expeditionary forces being projected ashore. The intent of this project will be to develop the technology that will lead to a quickly deployed CB agent early warning capability to support forces participating in amphibious operations. Specifically, the intent is to develop the agent detection subsystems of a CB detector payload for a 5"/62 gun projectile, which can be delivered by Naval guns for quick and accurate placement on the beach. The system must be rugged enough to withstand the forces associated with delivery(14,000 gs/300rev/sec), miniaturized to fit within size (290 cu in) and weight (18 lb) constraints and must be able to communicate alerts back to ships 23 miles off-shore. The subsystem should be capable of performing simultaneous analyses of multiple CB agents.

PHASE I: Determine the feasibility of a chemical/biological agent sampling/handling/detection subsystem that could be integrated with other subsystems (radio transmitter, power, etc) to produce a complete CB detector payload for 5"/62 gun projectiles.

PHASE II: Construct and demonstrate the sampling/handling/detection subsystem based on the design developed in Phase I. The demonstration system can be designed to detect a selected benign agent for proof-of-principle, however, the approach for extension to specific agents of interest in Phase III and beyond must be addressed. The system can be constructed at macro-scale levels for bench-top demonstration in Phase II. However, the system must be constructed using scaleable technology components that can be miniaturized and ruggedized in Phase III.

PHASE III: Design and construct a miniaturized and ruggedized sampling/handling/detection subsystem. Manufacture prototype units that can be incorporated into a complete munition payload Engineering Development Model. Final product objective for Phase III and beyond is a system that can simultaneously perform analysis of three to six agents.

COMMERCIAL POTENTIAL: The specific sensors developed would have significant potential for airport inspection applications and for remote sensing in public areas such as subway stations. Additionally, miniature automated titration analysis systems that can be manufactured in large numbers would be of significant interest to educational institutions and commercial chemical and pharmaceutical companies.

KEY WORDS: Chemical; biological; detection; titration; miniature; projectile

CBD00-202 TITLE: Miniaturized Gas Sampling Technology for a Chemical Dosimeter/Detector

TECHNOLOGY AREAS: Chemical/Biological Defense

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PM, Nuclear, Biological, & Chemical Defense System

OBJECTIVE: Develop a power efficient, miniature/lightweight gas sampling system for a chemical dosimeter/detector.

DESCRIPTION: A variety of detector technologies which do not require support gases (other than air) including surface acoustic wave (SAW), ion mobility spectrometry (IMS), photoionization (PI), chemiresistor (CR), quadrapole mass spectrometery (QMS) are available or are in development for the detection and monitoring of chemical agents. For hand held, dosimeter, or distributed monitoring, key development issues relate to size, weight and power consumption of detector components. For example, a miniature chemical dosimeter is highly sought after for personal monitoringdevice. The development of such a system requires a significant reduction in the form factor and power requirements of current enabling technologies. With the advance of the cellular communication technology, significant progress has been achieved in the power consumption level and real estate requirements for signal processing electronics. This is primarily achieved via novel semiconductor processes, and advanced circuit design techniques. In contrast, no concentrated effort has been applied to miniaturize the gas sampling system and reduce the associated power consumption. The gas sampling system is a generic concern to all detectors being developed. Innovative concepts are sought in the design, and implementation of a power efficient, miniature gas sampling system, which will sample ambient air for analysis and provide the ability to re-configure flow path via valve switching. The dimension of the sampling system should be no bigger than 2" wide x 3" long x 3/8" thick (not including battery), light-weight, chemically inert, and capable of providing a minimal of 500 ml/min flow rate. The system should operate under standard mil spec ambient conditions and from -5 PSI to 15

PSI pressure. The system should be powered by a light-weight battery for at least a 12-hour continuous operation. The concept, if proven successful, should be producible with an existing manufacturing technology.

PHASE I: Demonstrate the concept of a miniature gas sampling technology.

PHASE II: Implement the concept identified in Phase I and demonstrate the capability of the technology with a prototype system.

PHASE III: Identify commercial development partner(s) and provide commercialization plan and documentation for mass production.

DUAL USE: A miniature, personal chemical detector/dosimeter is highly sought after in the industry to monitor toxic industrial chemicals (TIC). The form factor and power requirements of existing personal detectors is too bulky to be used conveniently in the field. Furthermore, a power efficient, light-weight chemical dosimeter/detector allows long term medical studies to be carried out on an individual in the field.

KEYWORDS: gas sampling system, chemical dosimeter, miniaturization

CBD00-203 TITLE: Development of a Portable Aerosol Collector

TECHNOLOGY AREAS: Chemical/Biological Defense

OBJECTIVE: Develop a badge-sized aerosol collector using either electrostatic or electrodynamic precipitation to monitor personal exposure to BW agents. Apply the same technology to develop a small sampler that could be used to monitor areas within ships, aircraft cockpits and cabins, access repair panels for evidence of contamination.

DESCRIPTION: Personal detection of troops operating in the field at remote locations close to front lines or in high threat areas is lacking. In addition, viable technologies to monitor for contamination within or on aircraft, within ships and other assets is also lacking. The type of aerosol sampler required for personal/small area detection under such conditions would have to be a lightweight, reliable, quiet sampler, capable of operation without the use of battery packs or bulky pumps and little or no fluids. We propose to develop a portable sampler based on electrodynamic precipitation technology coupled with microelectronic manufacturing techniques. Electrodynamic precipitation works by establishing an electrical gradient that attracts particles. Electrodynamic sampling technologies have numerous advantages over more conventional sampling devices such as prolonged sampling, have no moving parts, and require no fluids to capture aerosol particles. When combined with microelectronic manufacturing, small samplers requiring very low power requirements can be manufactured. Such a sampler could be used as for monitoring an individual's exposure or that of a small area.

PHASE I: The first phase of this work would involve laboratory investigations focused on characterizing and optimizing sensitivity and capacity of an electrodynamic sampler. Work would also be directed towards applying micro-electronic manufacturing techniques towards development of such a sampler. Laboratory work would also include exposing the sampler to decreasing concentrations of simulant biowarfare agents to determine the senstivivity and the capacity of such as sampler.

PHASE II: The second phase of the research would be dedicated to development and testing of a prototype sampler in an aerosol chamber. Testing of the sampler would involve measuring collection of aerosolized target microorganisms will be aerosolized under various combinations of low and high humidity and temperature in the presence and absence of physical interferents such as dust, pollen, smoke and other small particulates. Known concentrations of interferent will be aerosolized during and after collection of target microorganisms. The results of interferent studies will be used to measure the effect of abiotic and biotic background particulates on sample collection and the effect of humidity and temperature on sample recovery.

PHASE III DUAL USE APPLICATIONS: Dual use of such a sampler includes measuring exposure of those working in BL3 and higher laboratories to exposure dangerous microorganisms. Such a sampler could also measure exposure of workers to dust, soot and other particulates encountered in potentially hazardous working environments such as mines, metal working shops and slaughterhouses. Such a sampler will also be useful in assessing the hazards found in compartments that need "gas-free" testing prior to entrance. The sampler could also be usful for collecting trace amounts of illicit substances.

KEYWORDS: Biological warfare, aerosol sampling, electrodynamic sampling, micro-electrical manufacturing, detection, aerobiology, biodetection.

CBD00-204 TITLE: Ultra-fast Cemical Agent Detector with Fast Gas Chromatograph (CG) Analysis

TECHNOLOGY AREAS: Chemical/Biological Defense, Sensors/Electronics/Battlespace

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PM, Nuclear, Biological, & Chemical Defense System

OBJECTIVE: Innovative chemical transducers are needed with fast "equilibrated" signal kinetics and/or optimized gas sampling pneumatics that increase the performance of technologies such as the surface acoustic wave (SAW) sensor. The chemical transducer developed should provide equilibrated signal responses to chemical agent simulants in <0.1 s and preferably <0.05s, and allow similar recovery times to signal baseline. Interface the transducer or transducer and developed pneumatics system to a "fast" GC system and demonstrate detector operation is capable of monitoring narrow eluting analyte GC peaks for chemical agent simulants. The simulants should have similar retention indices to actual chemical agents.

DESCRIPTION: Novel chemical transducers and sampling pneumatics are needed to improve the signal kinetics performance over and above existing detectors based on surface acoustic wave (SAW), ion mobility spectrometry (IMS), photoionization (PI), chemiresistor (CR), and quadrapole mass spectrometery (QMS). For hand held, dosimeter, or distributed monitoring, key development issues relate to size, weight and power consumption of detector components. One area of generic concern to all detectors is the signal response characteristics. Normally a sensitive, fast and reversible response are considered desirable. The areas that govern the signal response characteristics include the chemical transducer and the associated gas sampling pneumatics. Regardless of the core chemical detector technology involved, it is possible for false alarms to occur. One way to increase the performance of a detector is to include some form of collection/concentration and chromatographic capability to separate complex mixtures of gases prior to detection. The draw back with such an approach is the increased time involved in analysis. However with the advent of "fast GC" systems that can carry out complex analysis in less than 10 seconds, there is an increased need for detectors that can functionally be integrated to these GC systems. Unfortunately many current technologies are not compatible with the "fast GC" systems because the signal kinetics of the gas sensor technology are too slow. Transducer pneumatics can be direct to ambient air or involve a gas concentrating device (preconcentrator) that can then be interfaced to a gas chromatographic (GC) column that is serially connected to the detector of interest (eg. SAW, IMS, PI, CR, QMS). Ultra fast GC analysis with high performance (all nerve, mustard, and blood agents clearly separated) is possible for a complex mixture of agents in about 10 seconds. However, The eluting GC analyte peaks from such a GC column are extremely narrow with peak widths that are of the order of 0.5 s. In order for the detector to follow the trace of such a narrow peak, the detector should be able to respond and recover to signal baseline in <0.1 seconds and preferably <0.05 s. Current designs of detector technologies for example the Joint Chemical Agent Detector currently in its EMD phase (that do not require support gases) do not allow for this level of performance, so they are not currently able to take full advantage of the GC technology available. Development of innovative transducers and gas pneumatics to allow rapid equilibrated detector signal responses is highly desirable for a variety of chemical agent detector applications and would be advantageous in accomplishing effective integration with current fast GC systems. The resulting technological innovations are expected to be enabling to the SAW JCAD, JSPGM, and JTCOPS programs which all have requirements for detection of toxic gases. Commercial interest in chemical detectors with fast signal kinetics compatible with fast GC systems would be in field monitoring of chemicals at industrial locations, and in areas where toxic industrial chemicals are released into the environment.

PHASE I: Demonstrate the concept of a chemical transducer and/or pneumatics/chemical transducer capable of fast and reversible equilibrated signal kinetics to chemical agent simulants. The developed technology should allow detector gas sampling system and/or transducer detection and recover to signal baseline in <0.1s and preferably <0.05s.

PHASE II: Integrate the technology identified in Phase 1 with a fast GC system, and demonstrate the capability of the technology with a prototype system.

PHASE III DUAL USE APPLICATIONS: Identify commercial development partner(s) and provide commercialization plan and documentation for production.

OPERATING AND SUPPORT COST (OSCR) REDUCTION: The development of a chemical transducer/pneumatics with fast signal kinetics compatible with a "fast GC" would allow a much higher level of user confidence and reduce the need for multiple technologies or systems to confirm/deny detection/identification of agents. Reducing the need for multiple technologies would lead to a direct cost reduction.

KEYWORDS: Chemical Transducer, Pneumatics, Fast GC, Gas Chromatography, Equilibrated Signal kinetics

CBD00-205 TITLE: Particle Filter/Separator For Use In Biological Samplers

TECHNOLOGY AREAS: Chemical/Biological Defense

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PM, Nuclear, Biological, & Chemical Defense System

OBJECTIVES: The object is to develop reliable in-line filters and separators for use with biological sampling equipment at 800-1000 lpm flow rates. To prove feasibility and reliability of incorporating such devices into existing systems without reducing down stream function.

DESCRIPTION: There is a need to reduce the ingestion of 50 micron and larger particles from a biological wet sample. This need has arisen due to large particles causing clogging of particle counters (e.g. TSI APS and MetOne) and wet samplers in current biological agent detection systems. The base line particle sizes for biological agents are 2-10 micron with some clusters as large as 15 micron and as small as 1 micron. Background particles are found at many sites employing developed biological agent detection systems. These large particles have many sources and when the devices are constantly exposed to these sources clogging occurs. Some examples of sources are industrial waste and equipment exhaust as well as pollutants from controlled and uncontrolled burns (e.g. forest fires, controlled back-burns and the burning of old crop fields).

PHASE I: Phase I efforts should focus on experimentation to evaluate proposed filtering and/or separator technology. Filtering of particles 50 microns and above is desired. The filtering technology should not significantly reduce a flow rate of 800 - 1000 liters per minute. Initial demonstration of the technology should show that the desired particle sizes are filtered and particles below that size pass through.

PHASE II: Phase II will proceed if there is sufficient data collected to prove that this process of using a filter/separator is a reliable and efficient way to reduce large particles from entering into a biological sampler. Phase II efforts should focus on integration of the filter/separator technology into existing biological agent detection systems and full blown chamber testing to evaluate the efficacy and reliability of the developed technology.

PHASE III: The filter/separator would be placed on existing Biological sampling equipment used on Navy ships. This would include the Interim Biological Agent Detection System (IBADS). It could be used with the Joint Program Office (JPO) Portal Shield and JBREWS equipment. These devices would also have a use on future aerosol sampling equipment where applicable.

DUAL USE APPLICATIONS: These devices could be used within the civilian community where applicable, with biological detection equipment for anti-terrorism.

KEYWORDS: Filter, Separator, biological, testing

CBD00-206 TITLE: Field Rugged Man-Portable Chemical Biological(CB) Gas Chromatograph(GC) Mass Spectrometer(MS) for Environmental Assessments.

TECHNOLOGY AREAS: Chemical/Biological Defense, Weapons

OBJECTIVE: Assess Federal, State, and Local landfills, Chemical and Biological storage facilities(bunkers/ammo-dumps, etc...), Petroleum & Chemical Plant tanks(above & below ground), for surface contamination.

DESCRIPTION: The intent of this project is to quickly, and rapidly assess CB agents that permeate (filter) from stored 55-gallon drums, tanks, landfills, or pipelines in Petroleum plants. The CB GC/MS must be rugged enough to withstand forces associated with MIL-STD-810-E (environmental tests), shock & vibration, solar radiation, and be decontaminated using the current FM 3-5 (field decontamination manual), and or Federal, State, and Local laws and regulations. The CB GC/MS must be capable of ultimately performing simultaneous analysis of multiple CB agents, as well as, Toxic Industrial Chemicals (TIC's), Toxic Industrial Biologicals (TIB's). Engineering design, system development, risk identification, and the evaluation of the desired technical performance in systems specifications to achieve the systems objective must be evaluated.

PHASE I: Determine the feasibility of developing the Chem/Bio field rugged GC/MS for environmental assessments. The market survey/study must be based on the development of the Chem/Bio GC/MS that is both Man-portable, and safe to operate.

PHASE II: Build and demonstrate the proper handling, sampling, and detection capabilities of the CB GC/MS system based on Phase I design criteria's. The demonstration of the CB agent detection system can use "stimulus" to mimic the actual agent of interest (chem/bio), and "trigger" the alarm. The CB GC/MS can include the use of modeling & simulation, test beds, and prototypes of full-scale engineering development models of the system in Phase II. The objective is to test a "Pre-production" system that closely approximates the final product. Test & Evaluation's on Critical Technical Issues, and technical risks, trade-off evaluations on specifications, operational requirements, life-cycle-costs, schedule, as well as safety is determined.

PHASE III: Design and fabricate(build) a field rugged CB GC/MS that analysis the soil, and or ,vegetation for Toxic Industrial Chemicals(TIC's), and Toxic Industrial Biologicals(TIB's), and CB threat agents of interest. Production Acceptance Test & Evaluation(PAT&E) will be used to verify system compliance with the requirements and specifications of the contract. Tests that are described in the Test Evaluation Master Plan(TEMP), but not conducted during Phase II, are completed during Phase III. System elements are integrated into the final operational configuration, and development testing is completed when all system performance requirements are met.

COMMERCIAL POTENTIAL: The Field Rugged CB GC/MS could be used by Federal, State, and Local authorities to monitor landfills, wetlands, Petroleum & Chemical plant discharge(holding pit's ditches, etc..), and CB storage bunker's for CB threat agents seeping into ground water, or rising to the surface. Furthermore, the system when manufactured in large numbers, can possibly reduce the systems overall costs . This will give both DOD, and civilian authorities the capability to accurately "assess" TIC's, and TIB's, and CB agents of interest.

KEYWORDS: Chemical Biological, Toxic Industrial Chemicals (TIC's), Toxic Industrial Biologicals(TIB's, Detection, Ground Water Analysis, Soil Analysis

CBD00-207 TITLE: Mission-Oriented Protection Posture (MOPP) IV Ensemble Degradation Monitor

TECHNOLOGY AREAS: Chemical/Biological Defense

OBJECTIVE: Develop a miniature warning device that alerts the user when his/her MOPP IV suit is no longer safe to wear.

DESCRIPTION: This is a requirement to develop the technology to warn the user that his/her MOPP IV ensemble has degraded to the level of "discard", due to excessive wear, or decontamination of the ensembles composite materials. The intent is to quickly warn the operator/user that his/her MOPP IV ensemble has become hazardous to their health. The system must be small, easily attached to Load Bearing Gear(LBE), or to the MOPP IV ensemble itself. The system must survive MIL-STD-810-E(shock, vibration, solar radiation, etc...). The system will consist of a cylindrical(vial shape in nature), device, that has "2" indicator's; one is for "Clear(white bottom-half)", and the other is for "Discard(red top-half)".The system starts out in the "Clear" mode(white), and gradually increases to the level of "Discard"(red). The system once used will be considered as a consumable(throw-away), along with the MOPP IV ensemble, and properly discarded.

PHASE I: During Developmental Testing and Evaluation (DT&E), the systems components, sub-systems, and prototype development models will be tested. The Test and Evaluation functional compatibility, interoperability, and Integration with fielded and developing systems is included. During Phase I, adequate DT&E is accomplished to ensure engineering is reasonably complete, and that all significant design problems have been identified, and the solutions to these problems are in hand. This is when the system's risk identification, and system development will be scrutinized.

PHASE II: Build, and design during the Engineering and Manufacturing Development(EMD) phase to the systems actual detection capability of a degraded MOPP IV ensemble. The objective is to test a pre-production system that resembles the final product. Determine the systems performance limitations, safe operating parameters, environmental impact assessments, vulnerability, and logistical supportability. The assessment of the Critical Technical Issues, technical risks, and the evaluation of the operational requirements, life cycle costs, and schedule.

PHASE III: The final design of the system is conducted, and the tested to the Test Evaluation Master Plan(TEMP). Any test that is not conducted during Phase II, are completed during Phase III. The systems elements are integrated into the final operational configuration, and development testing is completed when all of the systems performance requirements are met. The Production Acceptance Test & Evaluation(PAT&E), are verified for system compliance with the requirements, and specifications of the contract. Deficiencies that are not corrected are recorded.

COMMERCIAL IMPACT: The commercial sector, and DOD are both candidates for this system. Once the system is "proven", and becomes available on the market, it's production potential(consumable), will be unlimited. HAZMAT teams, Fire Departments, Police(special-units) Forces, Rescue Squads, Hospitals, etc..., and the Department Of Defense will be highly interested in this particular system. The production of this system (device), will have a significant impact on the total "Life-Cycle-Cost" of the system.

KEYWORDS: HAZMAT, MOPP IV Suit, Chemical Biological Detection

Air Force CBD Topics

CBD00-301 TITLE: Discrimination of Biological Agents at Standoff Distances

TECHNOLOGY AREAS: Chemical/Biological Defense

OBJECTIVE: Develop and demonstrate a novel eyesafe, manportable, laser-based technique to discriminate biological agents from naturally occurring backgrounds at moderate standoff distances (up to 10 km).

DESCRIPTION: This topic solicits innovative and creative solutions to a research and development (R&D) problem in moderate range standoff biological agent detection and discrimination. Possible detection techniques include, but are not limited to, discrimination of the bio particles by utilizing polarization and/or multiple scattering methods. Specifically excluded are the LIght Detection And Ranging (LIDAR) techniques known as DIfferential SCattering/DIfferential Absorption LIDAR (DISC/DIAL), since they are already being pursued in separate efforts. All innovative approaches are encouraged and will be considered, provided they meet Phase I and II technical goals.

As stated in the definition of the Joint Warfighting Capability Objective (JWCO) for CB Warfare Detection, the "Capability for standoff detection of biological and chemical agents is our single most pressing need." Also, one of the 2 Counterproliferation JWCOs is stated as the "Capability to detect and evaluate the existence of a manufacturing capability for weapons of mass destruction (WMD)." The current state-of-the-art biological detection system is the M94, a helicopter-mounted 1 micron scattering detection lidar. The eyesafe upgrade to this device is the Long-Range Biological Standoff Detection System (LR-BSDS). Both detect the presence of aerosol clouds at ranges of as great as 30-50 km. However, neither device is capable of discriminating between naturally occurring aerosols and those associated with a BW release. Another lidar, the Short-Range Biological Standoff Detection System (SR-BSDS), is currently being developed for evaluation. This device will be able to detect the presence of biologically-active particles within a naturally occurring aerosol environment. However, it utilizes non-eyesafe ultraviolet light, is severely limited in range, is quite large, and must be operated in darkness for maximum sensitivity. For example, it has been calculated that detection ranges at night are less than 1 km for minimum threat clouds. In addition, both the SR-BSDS and LR-BSDS are very large and expensive systems, weighing over 1000 pounds each, and require a dedicated vehicle such as a helicopter or HMMWV to house them and provide the power they need.

Naturally occurring atmospheric particles fall into the 0.3 to 0.7 micron range. On the other hand, particles onto which BW agent have been deposited are much larger (2-10 microns). If radiation impinges in clouds of these materials, it is well-known that the larger particles will cause the radiation to be much more multiply reflected. Thus, it is possible to discriminate clouds of BW agents by measuring the relative amounts of the singly and doubly backscattered signals. This can easily be done by using a LIDAR with detectors that are viewing both on and off axis.

In addition, it known that the particles onto which the bio agents are deposited are cylindrical (or at least non-spherical) in shape. This gives rise to the possibility that they will be sensitive to polarized light. Since it has been established that naturally-occurring dust has no such polarizing qualities, there is a possibility that this fact can be used to discriminate bio particles from the atmospheric background. Preliminary calculations show that identification of the bio-aerosols could be possible at ranges up to 10 km if either of these techniques prove viable.

PHASE I: Measurements will be made to indicate the feasibility of the method proposed to discriminate bio clouds from natural backgrounds. Specifically, at least the biosimulant bacillus globigii (BG) will be considered. If possible, other materials including known binders for BW agents will also be examined as well as the effect of growth media. These data will be used to specify the design characteristics and project the performance of a moderate range (5-10 km) lidar using a novel bio-discrimination technique.

PHASE II: Construct or assemble a manportable breadboard lidar that will emit wavelengths shifted to eyesafe regions by optical parametric oscillation (OPO) or other techniques. The lidar will be used in field tests to demonstrate that the proposed novel technique can be used to identify BW simulants from naturally occurring aerosols at ranges of up to 5-10 km.

PHASE III DUAL-USE APPLICATIONS: Phase III military applications include manportable, standoff CB detectors for contamination avoidance, decontamination, and counterproliferation. Phase III commercial applications include detectors for standoff environmental pollution monitoring.

KEYWORDS: chemical, biological, detection, carbon dioxide laser, LIDAR, standoff, sensitivity, system noise.

CBD00-302 TITLE: In-flight Decontamination

TECHNOLOGY AREAS: Chemical/Biological Defense

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PM, Nuclear, Biological, & Chemical Defense System

OBJECTIVE: Develop and demonstrate technology that can be used to decontaminate (neutralize) personnel and cargo while in-flight for both rotary and fixed-wing aircrafts.

DESCRIPTION: The capability to decontaminate (neutralize) personnel and cargo while in-flight is extremely valuable to the military. The technology needs to be lightweight, highly efficient, environmentally friendly, non-toxic to personnel, and materials compatible with the inside of an aircraft (both rotary and fixed-wing). This capability will allow personnel to lower protective levels and reduce the physiological and pyschological burden of being in protective gear in an enclosed space for a long duration. In addition, the overall system needs to be air-worthy in order for its use aboard an aircraft.

PHASE I: Develop and demonstrate feasibility of technology to decontaminate (neutralize) personal protective equipment (suits and masks) and cargo (typical materials like cardboard, tarp, plastic covers, etc) contaminated with simulants in an enclosed space. The technology must be environmental friendly and have no side effects on personnel inside the enclosed space.

PHASE II: The technology must be proven against "live agents." Develop and demonstrate an application system using the technology developed in Phase I. The system must be air-worthy, material compatible with the inside of aircrafts and usable by a single individual to decontaminate other personnel and cargo while aircraft is in-flight.

PHASE III DUAL-USE APPLICATIONS: Phase III military application will be for in-flight decontamination as required by the Joint Operation Requirements Document Joint Service Sensitive Equipment Decontamination (in final staffing). Phase III commercial applications for hazardous material clean-up for domestic preparedness and environmental pollutants.

KEYWORDS: chemical, biological, decontamination, hazardous material.

CBD00-303 TITLE: Thin, Flexible Chemical Agent Resistant Materials

TECHNOLOGY AREAS: Chemical/Biological Defense, Materials/Processes

OBJECTIVE: Develop a thin flexible 24 hr. military chemical agent resistant material for use in mask hoods, mask components and water containers.

DESCRIPTION: Current materials and their manufacturing processes for this application are very expensive and produce material that are bulky and not very flexible or can not last 24 hrs in a military chemical environment. Limitations in the current manufacturing processes do not allow the material to meet all of the requirements or allow the material to be versatile to meet all of the applications. The current specification that is used for mask hood material is MIL-C-51251. A new material shall be able to withstand military chemical agents and battlefield contaminants for a period of 24 hrs. The following is a list of the contaminants:

Contaminant	Test Method
Methyl Ethyl Ketone (MEK)	MIL-STD-810E
Isopropanol	MIL-STD-810E
Diesel Fuel	MIL-STD-810E
Gasoline	MIL-STD-810E
Toluene	MIL-STD-810E
Acetone	MIL-STD-810E
Motor Oil	MIL-STD-810E
Bleach (1 teaspoon calcium hypochlorite per gallon of water)	MIL-STD-810E
NaOH 5%	MIL-STD-810E
VX (military chemical agent)	MIL-STD-282
TGD (military chemical agent)	MIL-STD-282
HD (military chemical agent)	MIL-STD-282
GB (military chemical agent)	MIL-STD-282
Insect repellent (N,N-Diethyl-m-tolumide)	MIL-STD-810E
DS2, Decontaminating Solution (Caustic)	MIL-STD-810E
Hydraulic Fluid	MIL-STD-810E
JP4 (Jet Fuel)	MIL-STD-810E
JP8 (Jet Fuel)	MIL-STD-810E
LSA (Lubricant Small Arms)	MIL-STD-810E
AFFF (Aqueous fire Fighting Foam)	MIL-STD-810E

The material shall be able to withstand boiling water for 4 hours.
The current material manufactured under MIL-C-51251 only meets the above list of contaminants for a period of six hours. Current materials that meet all of the above contaminants for a 24 hour exposure are very thick (.060” to .125” in thickness), not flexible, and expensive. The currently available thinner (.005” to .025” in thickness) materials can not withstand the battlefield

contaminants for 24 hours. The new material shall be thin (less than .015" in thickness), flexible (can withstand cyclic flexing at –60oF to 160o, Newark Flex – ASTM#D2097-69), have a low noise signature (comparable to the butyl coated cloth of MIL-C-51251), have a 10 kgf minimum puncture resistance (ASTM#D2582-67), have a weight less than 12 ounces per sq./yd and shall be FDA approved for potable water. The material shall be able to be integrated into multiple manufacturing processes such as heat sealing, ultrasonic welding, bonding, etc… The development of a new material/manufacturing process would allow for a number of the above requirements to be successfully met. The development of the material/manufacturing process shall also be concentrated on versatility to meet additional requirements through a secondary process performed to the material or combining additives to the material before processing.

PHASE I: Research any new developments in materials technologies. Research existing and new manufacturing techniques that can be applied. The research shall be concentrated in developing three candidate materials using combinations of new and existing materials and manufacturing processes.

PHASE II: Further develop the candidate materials/manufacturing process and provide samples of the materials for evaluation. Conduct testing to evaluate their resistance to chemical agents and battlefield contaminants. Characterize the candidate materials physical properties for strength, tear resistance, durability, temperature performance and flame resistance. Develop a matrix that evaluates cost and performance of all the candidate materials. Construct mask hood and water container prototypes from all of the candidate materials.

DUAL-USE APPLICATIONS: The candidate materials will have a significant applications in the current developmental mask programs such as the Joint Service General Purpose mask, Joint Service Aircrew Mask and the Air Warrior. The candidate materials will also have application for other programs such as chemical protective clothing and gear. Industry will also have a use for the developed materials in the first responders and firefighter's chemical gear.

CBD00-304 TITLE: Open Wound Decontamination

TECHNOLOGY AREAS: Chemical/Biological Defense

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PM, Nuclear, Biological, & Chemical Defense System

OBJECTIVE: Develop and demonstrate technology that can be used to decontaminate (neutralize or remove, preference is neutralization) chemical and biological agents in open-wounds of casualties personnel.

DESCRIPTION: The capability to decontaminate (neutralize or remove, preference is neutralization) chemical and biological warfare agents in open-wounds of casualties is extremely valuable to the military. This capability will increase the safety and survivability of casualties and personnel in the course of medical treatment of casualties in a chemical and biological contaminated environment. The technology needs to be rapid but mild due to the sensitive nature of open-wounds. This capability will allow medical personnel to more readily treat casualties in a safe and effective manner.

PHASE I: Develop and demonstrate feasibility of technology to decontaminate (neutralize or remove, preference is neutralize) contamination in open-wounds. The demonstration will use simulants for the warfare agents and medically approved laboratory substitutes for open-wound conditions. The initial focus will be on chemical warfare agents using simulants for GB, VX and HD.

PHASE II: The technology must be proven against "live agents" with medically approved laboratory substitutes for open-wound conditions. The technology must have the potential to be FDA approved for human use.

PHASE III DUAL-USE APPLICATIONS: Phase III commercial and military application will be for treatment of casualties that have been contaminated with hazardous materials. This application benefits the military in chemical and biological warfare contaminated environments. The commercial use will be in treatment of personnel injured during hazardous material clean-up, domestic preparedness situations, and environmental pollutants.

KEYWORDS: chemical, biological, decontamination, hazardous material, open-wound, medical.

CBD00-305 TITLE: Multi-Component Adsorption Data and Modeling

TECHNOLOGY AREAS: Chemical/Biological Defense

OBJECTIVE: Develop and demonstrate a model to predict adsorption and desorption processes for a range of chemicals to provide a better understand of real world issues associated with air purification filtration systems in the presence of multi-contaminants.

DESCRIPTION: Military air purification filters remove heavy-vapor contamination by adsorption. Future regenerative filtration systems designs are based on understanding how vapors are adsorbed and desorbed. Complex interactions between adsorbed water and heavy vapors, e.g., nerve agents, cause this to be a poorly understood phenomenon. Fundamental studies, both experimental and modeling, are needed to more completely describe and understand the resulting multi-component adsorption process.

Vapors of prime interest are CW nerve and blister agents that boil between approximately 150 and 300 C. Studies using simulants which have similar vapor pressures and water solubility are recommended. Results should include adsorption equilibrium data on microporous adsorbents of interest to DoD at a variety of relative humidity and temperatures and an effort to correlate the data.

PHASE I: Measurements of adsorption equilibria on select microporous adsorbents will be made of simulants which have similar vapor pressure and water solubility to chemical warfare nerve and blister agents at a variety of relative humidity and temperatures. The collected data will be empirically modeled to attempt to correlate the data.

PHASE II: The empirical model developed in Phase I will be expanded to a theoretical model and the database of chemical adsorption and desorption processes will be expanded to include typical battlefield interferents and a select list of toxic industrial materials.

PHASE III DUAL-USE APPLICATIONS: Phase III commercial and military applications include filtration systems for both collective and individual respiratory protection; e.g. environmental control systems and respiratory masks. The military applications will involve warfare agents whereas the commercial applications for environmental pollutants.

KEYWORDS: chemical, biological, filtration, adsorption, desorption, regenerative, modeling.